APPENDIX A

STATEMENT OF WORK

BUILDING A BRIDGE TO THE CORN ETHANOL INDUSTRY

July 27, 1998

1.0 INTRODUCTION

The Biofuels Program at the National Renewable Energy Laboratory (NREL), under guidance from the Department of Energy's (DOE) Office of Fuels Development (OFD), is working to facilitate the commercialization of lignocellulosic biomass, i.e. corn fiber, corn stalks, and wood to ethanol for use as a transportation fuel. OFD's ultimate vision is the large-scale production of ethanol from biomass to serve the nation's transportation needs.

To make this vision a reality, OFD supports research of process technologies, feasibility studies, and related commercialization activities by national laboratories, universities, private industry, research foundations, and other government entities. In addition to technical achievement, substantial market development must also occur with the expectation that industry leaders will emerge as the route to commercialization is clarified.

Building the Bridge

OFD recognizes the leadership potential of the existing grain processing industry. Their resources and experience provide the grain processing industry with the ability to lead commercialization of biomass to sugars and ethanol. The grain processing industry is the largest contributor to current ethanol and sugar production. To better determine the commercialization possibilities for the industry, site-specific engineering feasibility studies are desired. NREL will fund up to 80% of the feasibility study cost. Cost sharing can be in-kind expenses of the offer.

Recent feasibility studies for the production of sugars and ethanol from biomass at Greenfield sites have shown that capital expenditures contribute a large fraction of the cost, and must be reduced if the conversion process is to be economically viable in the near term. Adding on to an existing ethanol plant or other site with compatible processes may reduce capital and operating cost. Roads, utilities other process and operational infrastructure may be able to support increased operations and reduce the cost of sugar and ethanol production. Increased process utilization may also be possible. For example, wet millers ethanol production equipment is often idle during the summer to meet sweetener requirements for beverage customers.

Some process equipment modifications may be required for biomass conversion. Equipment modifications are often expensed rather than capitalized. Expensing costs for equipment modification may be a more favorable approach to financing a biomass conversion facility.

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Process Technology

Individual companies may not have access to lignocellulosic biomass conversion technology. To address this need and facilitate interest NREL will supply a description of process technology including process flow diagrams, material and energy balances, and equipment list. Information includes the performance of cellulose hydrolysis and hexose and pentose fermentations. Alternatively, respondents may use independent technology for their economic evaluation. This solicitation is intended to help qualify respondents to evaluate the potential of the conversion technology not to assess the value of any particular process technology.

The feasibility study can assume cellulase enzyme cost on a per gallon of ethanol produced basis utilizing a range of costs from 5¢ to 45¢ per gallon of ethanol. On site cellulase production technology can be utilized if available to the proposer.

Raw Materials

Biomass feedstocks comprise one of the largest sustainable resources on earth. They are produced in quantity from agricultural and forestry activities, and are largely considered to be residue and waste. Locating a biomass conversion facility close to the feedstock can minimize the cost of transporting the materials. Facilities that produce their own biomass materials and are in the area of crop production already have access to low-cost biomass feedstocks.

Grain processing sites are located near grain and agricultural residues. Wheat straw is the single largest agricultural residue. Most grasses, hays, and straws have cellular structures similar to wheat straw, so a conversion technology that will work with wheat straw will also work with these other potential feedstocks.

Processing starch to ethanol produces corn fiber and spent grain, which are sold for animal feed because of their protein and fiber contents. Animal feed markets and value have been in decline, and other outlets for the corn fiber are desired. One possible use for corn fiber is conversion to ethanol.

In 1997 NREL performed an assessment of agricultural residue for feedstock. Sustainable wheat straw collection estimates are between 60 and 120 million tons per year, equivalent to at least 5 billion gallons of ethanol and possibly as much as 12 billion gallons per year. Cost per dry ton delivered to the processor was $32/dry ton for 50,000 acres contracted by a custom harvester for the '97-'98 crop year. The successful operation is being expanded to 100,000 acres this year. Productivity improvements are expected to reduce the costs to less than $30/dry ton, or about 35¢/gallon ethanol.

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Cellulase Enzymes

The costs of cellulase enzymes are also important to the commercial viability of a biomass conversion facility. In 1997 NREL performed an assessment of cellulase enzymes utilizing worldwide industry and academia input. The consensus position captured by the assessment showed cellulase enzyme costs can be lowered 5 to 10 fold by using proven biotechnology tools, reducing the cellulase enzyme cost from 45¢ to 5¢ per gallon ethanol. NREL is working with industry, universities, and other national labs to facilitate this cost reduction.

Purpose

The goals of this project are:

- Provide the grain processing industry the opportunity to explore the business potential provided by converting biomass to sugars via hydrolysis and fermentation to products such as ethanol.

- Take advantage of the grain-processing infrastructure by investigating the co-location of biomass conversion facilities at existing plant sites.

- Obtain feedback from the grain processing industry to guide the research and development activities for biomass conversion commercialization.

Scope

The subcontractor will develop a feasibility study for a biomass conversion facility co-located at an existing grain processing facility to evaluate the business opportunity. This facility will hydrolyze biomass to sugars and ferment the sugars to products, including ethanol. The feasibility study will consist of the tasks outlined in section 3.0.

2.0 OBJECTIVES

The technical objectives of the work are designed to evaluate the business opportunity for lignocellulosic biomass conversion for a specific processing site. Additionally, the information generated should provide an overall perspective to the grain processing industry on biomass conversion. This should allow the subcontractor to provide the Biofuels Program's Ethanol Project feedback on actions to improve the business opportunity.

- Specify a process flow diagram and utility requirements for the biomass conversion facility.

- Identify typical capital equipment located at an extant grain-processing site; determine its availability and necessary modifications for use by a co-located biomass conversion facility.

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- Identify additional infrastructure requirements of a co-located biomass conversion facility.
- Determine the production capacity of a co-located biomass conversion facility.
- Determine equipment needs for a co-located biomass conversion facility.
- Produce a Pro forma and perform sensitivity analysis on the effects of added capacity, capital required, cellulase enzyme, and feedstock cost on the production costs of sugars and ethanol.

3.0 TASK SPECIFICATIONS

The subcontractor shall assemble a team with the expertise to address these tasks in some detail. NREL will provide technical support to the project (see task for details).

Task 1 Feedstock Description

Describe the types of feedstocks to be used. This description should include:

- Percentage of each feedstock
- Total sugar content/lignin content/ash content
- Estimate of feedstock cost.

NREL will provide access to wheat straw and agricultural residue collection, storage, and harvesting models on request. Also, NREL will provide total carbohydrate, lignin, and ash percentages for wheat straw and corn fiber.

Task 2 Facility Description

Subtask 2.1 The subcontractor shall supply specifications about the grain processing facility as they relate to the proposed biomass conversion facility.

- Facility production capacity (annual sugar and ethanol production).
- Site description
- Infrastructure description (utilities, water, waste disposal, roads, rail)
- Size, required modifications, production parameters, and availability of capital equipment and infrastructure that will be shared.

Subtask 2.1 The subcontractor shall specify process related requirements for the biomass conversion facility . These shall include:

- Minimum feedstocks supply quantities and expected quality mix
- Ethanol production rate in gal/day and solid by-product rate
- Environmental emission characteristics, in terms of quantity emitted per ton of feedstock processed
- Area requirements (acres) and preferred shape
- Utility and chemical requirements (water, steam, fuel, power, chemicals)
- Special transportation requirements (truck, water, rail line)
- Special storage requirements for feedstock, by-products, and chemicals.
- NREL will supply feedstock composition, process technology for hydrolysis and hexose, pentose fermentation, flow diagrams, material and energy balance, equipment list, and operating parameters for a typical biomass conversion facility upon request.
- Cellulase production is not required.
- Other available process technology may be used.

Subtask 2.3 The subcontractor shall develop capital and operating costs based on process considerations.

The subcontractor shall provide annualized capital and operating costs for the island of process equipment (exclusive of site-specific costs) for a biomass conversion facility sized to fit the constraints of the existing facility, and shall define feedstock quality and cost assumptions used in the analysis.

Task 3 Capital and Operating Cost Refinement

The subcontractor shall review and refine the capital and operating costs defined in Subtask 2.3. The subcontractor shall provide a list of major process equipment specifications and prepare a capital cost estimate accounting for direct and indirect costs. An example of direct and indirect costs follows:

Direct Costs	Indirect Costs
Site Work	Construction Indirects
Concrete Work	Startup
Structural Steel	Construction Management
Equipment	Engineering
Piping	Contingency
Electrical	Environmental Permitting

Buildings	Insurance
Instrumentation	Taxes
Insulation/Piping	Plant Closure

It is anticipated that the estimating effort shall lead to a capital cost estimate with an accuracy of ± 30%. The subcontractor shall prepare an operating cost estimate based on the anticipated specific operating costs at the preferred site.

Task 4 Financial Pro Forma Preparation

The subcontractor shall prepare a financial Pro Forma for the construction and long-term operation of the biomass conversion facility. All assumptions in the Pro Forma shall be clearly identified and a rationale given for each assumption. The Pro Forma shall be prepared for 10 years of plant operation. The financial evaluation shall incorporate the site-specific capital, equipment modifications, startup cost, and operating costs as determined in Task 3 and shall determine the feedstock cost and the market value of the ethanol and other possible by-products that provide for a financially attractive return on equity.

Task 5 Sensitivity Analysis

A sensitivity analysis shall be performed for varying ethanol prices and capacity-added capital required feedstock costs, ethanol yield, and cellulase cost. The subcontractor shall provide anticipated best and worst case scenarios based on the sensitivity analysis. The projected profit over 10 years per gallon of ethanol shall be included in the Pro Forma.

Task 6 Monthly Status Reports

The subcontractor shall submit monthly status reports in letter form summarizing the progress of Task 1 to Task 5, during the previous month.

Task 7 Final Report

The subcontractor shall submit a final report that contains an executive summary, a synopsis of Task 1 - Task 5 results, conclusions, and recommendations for further work.

4.0 DELIVERABLES

DELIVERABLES	
#	**DESCRIPTION**
1	Task 1. And 2. Biomass conversion plant size, and equipment and infrastructure requirements
2	Task 3. Capital and operating cost refinement
3	Task 4. Financial Pro Forma

4	Task 5. Sensitivity analysis
5	Task 6. Monthly status reports
6	Task 7. Final report

Copies of all deliverables shall be sent to the Technical Monitor and the Subcontract Administrator as follows:

Original Copy to the Technical Monitor:

National Renewable Energy Laboratory
Attn: Art Wiselogel, MS 1634
1617 Cole Boulevard
Golden. CO 80401-3393

One Copy to the Subcontract Administrator:

National Renewable Energy Laboratory
Attn: John W. Enoch, Jr., MS 1632
1617 Cole Boulevard
Golden, CO 80401-3393

5.0 PERIOD OF PERFORMANCE

The period of performance for the proposed work shall not exceed 9 months.

APPENDIX B

Feedstock Availability Study

Portales, New Mexico

April 28, 1999

Presented to:

SWAN Biomass Company

By: Mike Davis

Overview

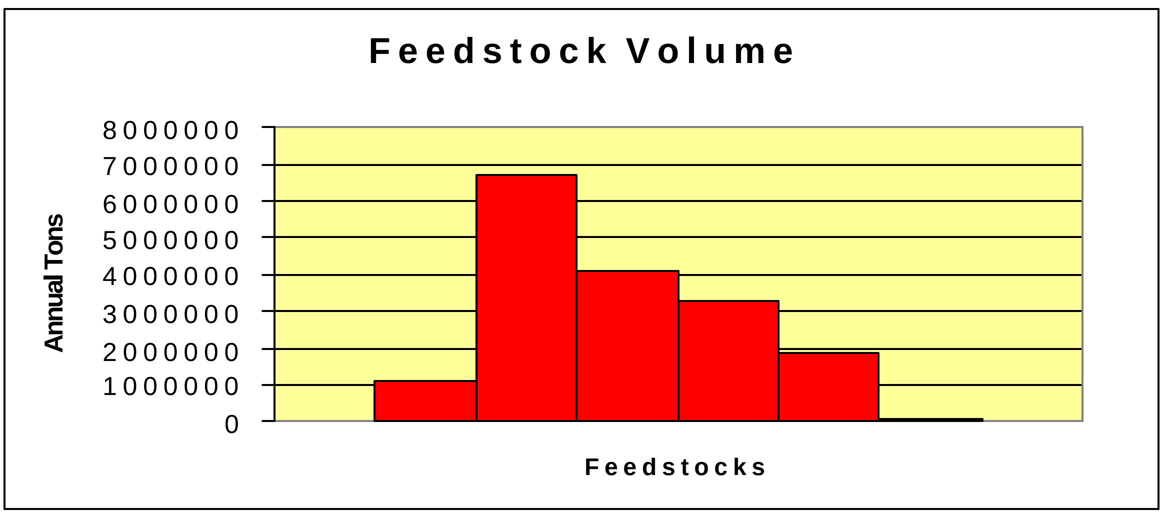
The objective of this study is to evaluate the availability, cost and feasability of harvesting substantial and reliable sources of feed stock material for the High Plains Ethanol facility located in Portales, New Mexico. Interviews were conducted by phone, and in person, in and around the Portales, New Mexico area. I met with processors, harvesting companies, farmers, truckers, feed brokers, government and academia in western Texas and eastern New Mexico. I have established volumes and pricing of material in the region based on these interviews and site visits.

Substantial feed stocks identified in the region include cotton gin trash, sorghum stover, wheat straw, corn silage, corn stover, and peanut hulls.

This study has identified over 17,000,000 tons of available feedstock in eastern New Mexico and Texas. The following pages break down this volume.(The information contained in this study is a best effort estimate with out guarantee.)

<u>Feedstock Volume and Price Summary</u>

Cotton Gin Trash	
Total Tons in Eastern New Mexico and Texas	**1,089,138.00**
Estimated Average Cost Per Ton	**$ 11.57**
Sorghum Stover	
Total Tons in Eastern New Mexico and Texas	**6,735,000.00**
Estimated Average Cost Per Ton	**$ 41.18**
Wheat Straw	
Total Tons in Eastern New Mexico and Texas	**4,086,300.00**
Estimated Average Cost Per Ton	**$ 46.43**
Corn Silage	
Total Tons in Eastern New Mexico and Texas	**3,286,600.00**
Estimated Average Cost Per Ton	**$ 37.54**
Corn Stover	
Total Tons in Eastern New Mexico and Texas	**1,879,600.00**
Estimated Average Cost Per Ton	**$ 40.39**
Peanut Hulls	
Total Tons in Eastern New Mexico and Texas	**62,529.00**
Estimated Average Cost Per Ton	**$ 31.14**



Total Tonnage in Study Area:	**17,139,167.00**
Average Price	**$ 39.73**

Cotton Gin Trash

Eastern New Mexico grows approximately 37,000 acres of cotton, generating over 54,000 bales of cotton. Information for Texas is statewide, thought he majority of the cotton is produced in the western portion of the state. The high and low plains region of the state grows approximately 3,300,000 acres of cotton, producing over 3,000,000 bales. The estimated gin trash produced in this area is approximately 700 pounds per bale. The combined total generation of gin trash in this region is approximately **1,089,138 tons per year.**

Cotton gin trash is currently sold as animal feed, composted, and land applied. The animal feed market will pay $10.00 per ton FOB gin for ground cotton gin trash. Un–ground cotton gin trash is given away to composters and in some cases is delivered to farmers fields for free. Cotton gin operators indicated that they would be interested in long term, contracted outlets for their material at no cost. While a portion of this material will continue to go to animal feed, a significant volume could be diverted to High Plains Ethanol for the cost of **transportation only**. (Please see the attached pricing schedule for estimated delivery prices.)

Un-ground Cotton Gin Trash

15,000 ton stock pile

Cotton Gin Trash

Eastern New Mexico Feedstock Pricing

FOB Price: --

County	**Trans.**	**Tons**	**Del. Price per ton**	**Total**
Guadalupe	$ 13.95	--	$ 13.95	--
Quay	$ 9.82	560	$ 9.82	$ 5,499.20
Eddy	$ 18.11	5,733	$ 18.11	$ 103,824.63
Curry	$ 5.00	1,418	$ 5.00	$ 7,087.50
Debaca	$ 9.00	--	$ 9.00	--
Chaves	$ 10.35	4,550	$ 10.35	$ 47,092.50
Lea	$ 12.26	4,340	$ 12.26	$ 53,208.40
Roosevelt	$ 5.00	2,538	$ 5.00	$ 12,687.50
Total		**19,138**		

Total Tons within New Mexico
Estimated Average Delivered Cost Per Ton **$ 11.99**

Texas Feedstock Pricing

State	$ 11.56	**1,070,000**	$ 11,56	$ 12,369,200

Estimated Average Delivered Cost Per Ton **$ 11.56**

Total Tons in Eastern New Mexico and Texas	**1,089,138**
Estimated Average Delivered Cost Per Ton	**$ 11.57**

Sorghum Stover

Eastern New Mexico grows approximately 217,500 acres of sorghum. Texas Department of Agriculture figures shows 3,150,000 acres were grown in 1997. Using the estimate that an acre of Sorghum will produce approximately two tons of in field waste, there appears to be approximately **670,000 tons** of sorghum stover generated on an annual basis in eastern New Mexico and Texas.

Livestock pasture appears to be the only use for sorghum stover at this time. Harvesting sorghum stover is not a common practice. However, if we utilize similar harvesting equipment to that of harvesting wheat straw we can establish an estimated cost of harvesting to be approximately **$30 per ton fob**. (Please see the attached pricing schedule for estimated delivered prices.)

Sorghum Stover

Eastern New Mexico Feedstock Pricing

FOB Price: $ 30.00

County	**Trans.**	**Tons**	**Del. Price per ton**	**Total**
Guadalupe	$ 13.95	800	$ 43.95	$ 35,160.00
Quay	$ 9.82	47,600	$39.82	$ 1,895,432.00
Eddy	$ 18.11	600	$ 48.11	$ 28,866.00
Curry	$ 5.00	192,000	$ 35.00	$ 6,720,000.00
Debaca	$ 9.00	--	$ 39.00	--
Chaves	$ 10.35	800	$ 40.35	$ 32,280.00
Lea	$ 12.26	6,000	$ 42.26	$ 253,560.00
Roosevelt	$ 5.00	187,200	$ 35.00	$ 6,552,000.00
Total		**435,000**		

Total Tons within New Mexico
Estimated Average Delivered Cost Per Ton **$ 35.67**

Texas Feedstock Pricing

State	$ 11.56	**6,300,000**	$ 41.56	$ 261,828,000

Estimated Average Delivered Cost Per Ton **$ 41.56**

Total Tons in Eastern New Mexico and Texas	**6,735,000**
Estimated Average Delivered Cost Per Ton	**$ 41.18**

Wheat Straw

The 1996 data on the eight surrounding New Mexico counties of Guadalupe, Quay, Curry, DeBaca, Roosevelt, Chaves, Lea and Eddy shows approximately 100,000 acres of wheat for grain being grown. The information for Texas is not broken down by region, only by state. However, the high plains region on the westside of the state is the major producer of wheat. Texas grows approximately four million acres of wheat. Wheat straw generation can fluctuate between one half ton per acre to two tons per acre depending on farming and harvesting practices. Using an average of one ton per acre it could be assumed that there would be approximately **4.1 million tons of straw** generated in the eastern New Mexico, and western Texas region.

I could not find any substantial competition for this material. The most common practice for dealing with straw is tilling it into the soil. In my discussion with harvesters, farmers could be enticed to bale their straw for $35 to $40 per ton FOB. Unless the crop was within five miles of the ethanol plant, freight would need to be added to the cost of this product. (Please see the attached pricing schedule for estimated delivered prices.)

In most cases the baled straw could be stored at the farmers field side until required at the facility.

Wheat Straw

Eastern New Mexico Feedstock Pricing

FOB Price: $ 35.00

County	Trans.	Tons	Del. Price per ton	Total
Guadalupe	$ 13.95	1,100	$ 48.95	$ 53,845.00
Quay	$ 9.82	3,000	$44.82	$ 134,460.00
Eddy	$ 18.11	100	$ 53.11	$ 5,311.00
Curry	$ 5.00	64,000	$ 40.00	$ 2,560,000.00
Debaca	$ 9.00	100	$ 44.00	$ 4,400.00
Chaves	$ 10.35	900	$ 45.35	$ 40,815.00
Lea	$ 12.26	2,400	$ 47.26	$ 113,424.00
Roosevelt	$ 5.00	14,700	$ 40.00	$ 588,000.00
Total		**86,300**		

Total Tons within New Mexico
Estimated Average Delivered Cost Per Ton **$ 40.56**

Texas Feedstock Pricing

State	$ 11.56	**4,000,000**	$46.56	$ 186,240,000

Estimated Average Delivered Cost Per Ton **$ 46.56**

Total Tons in Eastern New Mexico and Texas	**4,086,300**
Estimated Average Delivered Cost Per Ton	**$ 46.43**

Corn Silage

The eight eastern New Mexico Counties surveyed for this study reported approximately 22,000 acres of corn silage grown in the region. Corn Silage grown in Texas equaled 150,000 acres, generating approximately 2,850,000 tons. Corn silage is typically grown for livestock feed and the harvesting equipment is already in place. For that reason we can generate fairly accurate production data. This region produced 3,286,600 tons of silage in 1997 or just over twenty tons per acre.

Corn Silage typically sells for approximately $20.00 per ton in the field. The cost of harvesting at $6.50 per ton plus the cost of freight, make this high moisture material fairly expensive. (Please see the attached pricing schedule for delivered prices.) Livestock demand will keep this feedstock higher priced than some of the other alternatives.

Corn Silage

Eastern New Mexico Feedstock Pricing

FOB Price: $ 26.50

County	Trans.	Tons	Del. Price per ton	Total
Guadalupe	$ 13.95	--	$ 40.45	--
Quay	$ 9.82	8,400	$ 36.32	$ 305,088.00
Eddy	$ 18.11	--	$ 44.61	--
Curry	$ 5.00	104,000	$ 31.50	$ 3,276,000.00
Debaca	$ 9.00	--	$ 35.50	--
Chaves	$ 10.35	110,000	$ 36.85	$ 4,053,500.00
Lea	$ 12.26	73,500	$ 38.76	$ 2,848,860.00
Roosevelt	$ 5.00	140,700	$ 31.50	$ 4,432,050.00
Total		**436,600**		

Total Tons within New Mexico
Estimated Average Delivered Cost Per Ton **$ 34.16**

Texas Feedstock Pricing

State	$ 11.56	**2,850,000**	$ 38.06	$ 108,471,000

Estimated Average Delivered Cost Per Ton **$ 38.06**

Total Tons in Eastern New Mexico and Texas **3,286,600**
Estimated Average Delivered Cost Per Ton **$ 37.54**

Corn Stover

Corn stover is regarded as that material which is left behind after harvesting the grain from the Corn plant in the field. The corn for grain acreage within the eight surrounding eastern New Mexico counties equaled, 43,200 acres. Texas acreage equaled 1,750,000. One acre of corn will produce approximately two tons per acre of corn stover. The 1,793,200 acres of corn should produce approximately 3,600,000 tons of corn stover.

Corn stover, if harvested at all, is typically baled. The stalks are first cut, raked and then Baled. Balers used in this area have been either 1,000 pound round bales or large 1,800 pound square bales. The square bales are preferred over the round bales due to their ease of handling and increased payload. Care must be taken in the harvesting practice to minimize the percentage of soil contamination in the corn stover. Corn stover becomes available for harvest in mid-September. Baling cost for corn stover is estimated to be $25.00 per ton. (Please see the attached pricing schedule for estimated delivery prices.)

Corn Stover

Eastern New Mexico Feedstock Pricing

FOB Price: $ 30.00

County	Trans.	Tons	Del. Price per ton	Total
Guadalupe	$ 13.95	--	$ 43.95	--
Quay	$ 9.82	1,000	$ 39.82	$ 39,820.00
Eddy	$ 18.11	--	$ 48.11	--
Curry	$ 5.00	55,200	$ 35.00	$ 1,932,000.00
Debaca	$ 9.00	--	$ 39.00	--
Chaves	$ 10.35	1,400	$ 40.35	$ 56,490.00
Lea	$ 12.26	--	$ 42.36	--
Roosevelt	$ 5.00	28,800	$ 35.00	$ 1,008,000.00
Total		**86,400**		

Total Tons within New Mexico
Estimated Average Delivered Cost Per Ton **$ 35.14**

Texas Feedstock Pricing

State	$ 11.56	**1,793,200**	$ 41.56	$74,525,392.00

Estimated Average Delivered Cost Per Ton **$ 41.56**

Total Tons in Eastern New Mexico and Texas	**1,879,600**
Estimated Average Delivered Cost Per Ton	**$ 41.27**

Peanut Shells

Portales area peanut processors process approximately 62,000,000 pounds of peanut annually. This volume generates between 4,000 to 4,500 tons of shells. Texas produces approximately 411,000 tons of peanuts generating 58,529 tons of shells.The peanut shells are currently sold as animal feed at the rate of $20.00 per ton FOB the processor site in Portales. (Please see the attached pricing schedule for estimated delivery prices.)

Peanut Hulls

Eastern New Mexico Feedstock Pricing

FOB Price: $ 20.00

County	**Trans.**	**Tons**	**Del. Price per ton**	**Total**
Guadalupe	$ 13.95	--	$ 33.95	--
Quay	$ 9.82	--	$ 29.82	--
Eddy	$ 18.11	--	$ 38.11	--
Curry	$ 5.00	--	$ 25.00	--
Debaca	$ 9.00	--	$ 29.00	--
Chaves	$ 10.35	--	$ 30.35	--
Lea	$ 12.26	--	$ 32.36	--
Roosevelt	$ 5.00	4,000	$ 25.00	$ 100,000
Total		**4,000**		

Total Tons within New Mexico
Estimated Average Delivered Cost Per Ton **$ 25.00**

Texas Feedstock Pricing

State	$ 11.56	**58,529**	$ 31.56	$ 1,847,175.24

Estimated Average Delivered Cost Per Ton **$ 31.56**

Total Tons in Eastern New Mexico and Texas	**62,529**
Estimated Average Delivered Cost Per Ton	**$ 31.14**

Estimated Mileage and Transportation Costs

Eastern New Mexico Counties:

Counties	Miles	Transportation Cost @ $2.30 per loaded mile	Cost/ton @ 20 tons/load
Guadalupe	124	$285.20	$14.26
Quay	87.3	$200.79	$10.04
Eddy	161	$370.30	$18.52
Curry*	30	$100.00	$5.00
Debaca	80	$184.00	$9.20
Chaves	92	$211.60	$10.58
Lea	109	$250.70	$12.54
Roosevelt*	10	$100.00	$5.00
Average	**86.66**	**$212.82**	**$10.64**

*(min. $5.00/ton)

Western Texas Cities:

Cities	Miles	Transportation Cost @ $2.30 per loaded mile	Cost/ton @ 20 tons/load
Muleshoe	49	$112.70	$5.84
Amarillo	122	$280.60	$14.03
Lubbock	118	$271.40	$13.57
Brownfield	127	$292.10	$14.61
Plainfield	110	$253.00	$12.65
Hereford	77	$177.10	$8.86
Average	**100.5**	**$231.15**	**$11.56**

Table 1. Chemical Composition of Cotton Gin Trash Samples

Feed	D.M.	C.P.	C. Fat	C. Fiber	Moisture	Ash	N.F.E.	Source
Cottonseed Trash	90.7	7.7	1.6	27.9	9.3	9.3	--	U.S.-Canadian tables of feed composition
Spindle-picked CGT unpelleted	90.69	5.94	3.16	31.78	9.31	11.04	38.78	Missippi
Stripper-harvested CGT pelleted	91.44	10.13	1.28	38.50	8.56	8.10	33.43	Texas
Loose CGT	93.7	6.3	1.0	33.2	6.3	12.1	39.9	Arizona
CGT cubes	88.32	10.43	2.44	25.0	11.68	19.53	--	Arizona
CGT cubes	93.06	10.55	1.90	20.29	6.94	28.44	--	Arizona
Loose CGT	78.20	7.4	4.5	20.0	21.8	14.9	--	New Mexico
CGT cubes	89.66	8.92	1.16	26.97	10.34	22.02	--	Arizona
	85.50	8.67	2.17	25.15	14.50	23.60	--	Arizona
	82.12	11.81	3.53	20.70	17.88	16.67	--	Arizona
CGT pellets	91.44	10.13	1.28	38.50	8.56	8.10	--	Texas
Cotton burrs	92.0	8.5	2.0	35.9	8.0	8.0	37.9	Texas
CGT	92.0	7.0	1.5	35.0	8.0	10.0	--	SRI

D.M. = Dry Matter
C.P. = Crude Protein (N x 6.25)
C. Fat = Crude Fat
C. Fiber = Crude Fiber
N.F.E. = Nitrogen-Free Extract

APPENDIX C

Selections from Project Monthly Reports (Feedstock Composition)

December 15, 1999

To: Art Wiselogel

Subject: **July 1999 Monthly Report**
Subcontract No. ZXE-8-18080-06

. . .

Additional analytical results on the cotton gin trash were received from Axion Analytical in July. Some of the results seem quite different from values reported in the literature, and repeats of several of the analyses were requested.

R.E. Lumpkin
Principle Investigator

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December 15, 1999

To: Robert Wooley

Subject: **August 1999 Monthly Report**
Subcontract No. ZXE-8-18080-06

Final analytical results were reported for cotton gin trash late in August. The composition of this material is given below. All numbers are on a dry basis, unless specified otherwise:

- 89.39% biomass (12.61% moisture)
- 41.6% carbon, 4.9% hydrogen, 1.15% nitrogen, 32.2% oxygen
- 0.85% fat
- 1.23% starch
- 2.52% acetic acid
- Lignin – Klaison 35.77%, 38.32%
  Acid Soluble 1.83%, 1.95%
- Total ash 8.79%
- Soluble ash 4.41%
- 22.08%, 24.74% total glucose, 1.30% soluble glucose
- 10.89%, 10.37% total xylose, 6.86% soluble xylose
- 1.49%, 1.49% total arabinose, 1.56% soluble arabinose
- 1.53%, 1.48% total galactose, 1.57% soluble galactose
- No measurable mannose
  {Ed. Note: The values below are presented for a moisture-containing sample}
- Cr, Co, Ni, Cu, Mo, Pb were absent or in amounts too low to measure.
- 371 ppm Na, 228 ppm Mg, 3207 ppm Al, 16,517 ppm K, 8914 ppm Ca, 138 ppm Ti, 33 ppm Mn, 1477 ppm Fe, 14 ppm Zn, 93 ppm Sr, 22,459 ppm Si, 1136 ppm P

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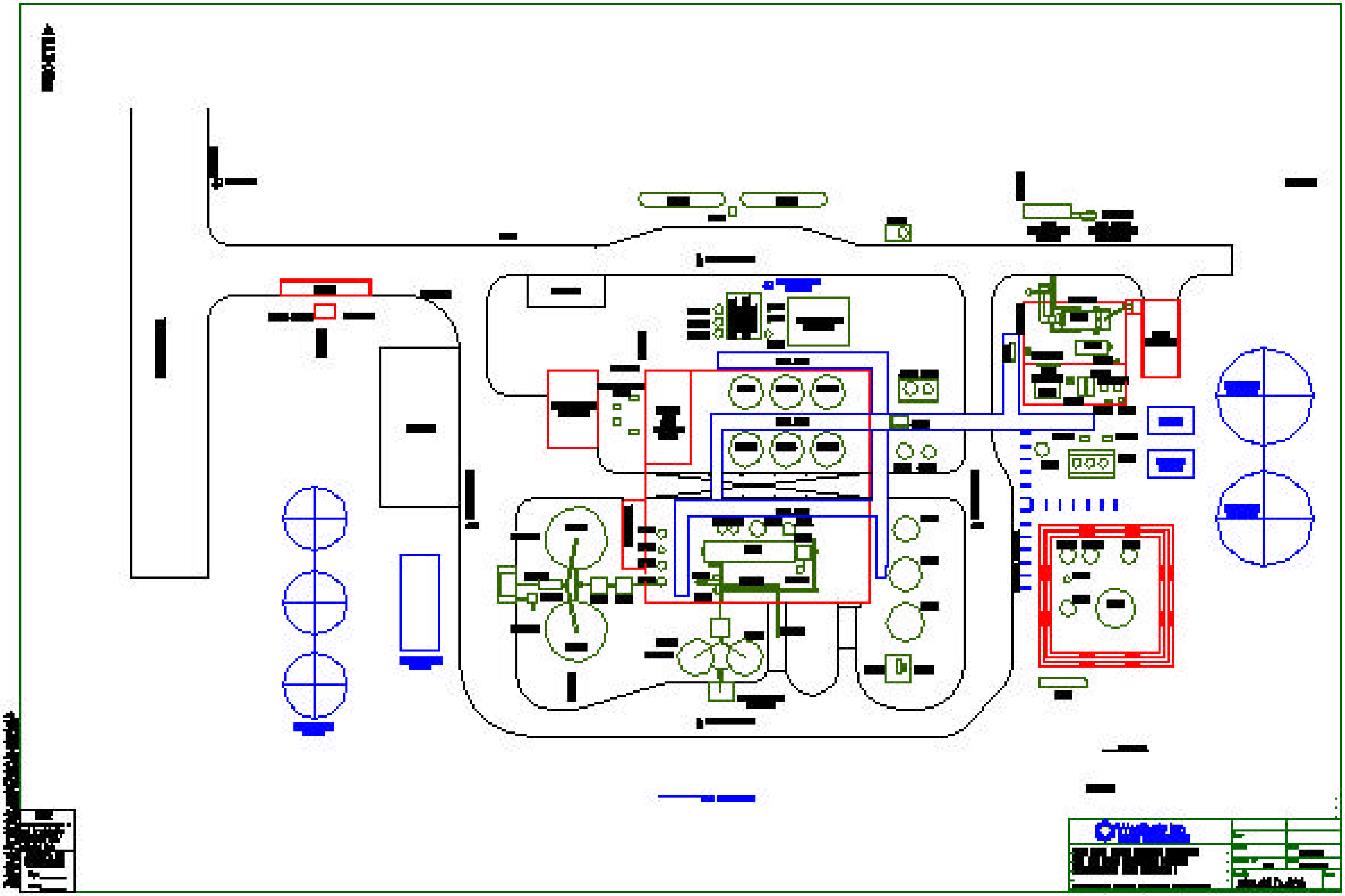
R.E. Lumpkin
Principle Investigator

APPENDIX D



References

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2. Merrick & Company, *Building a Bridge to the Corn Ethanol Industry*, November 1999, Appendix 1.

3. Stone & Webster Engineering Corporation, *et al.*, "Feasibility Study for Rice Straw-to-Ethanol in Gridley, California, Phase 1 Report", NREL Subcontract ZCG 6-15143-01, March 14, 1997. Page 8.